

National Marine Fisheries Service
Enhanced Particle Tracking Model (ePTM)
FAQ Sheet
February 2015

- **How is the enhanced Particle Tracking Model (ePTM) different than the standard PTM module of DSM2?**

The standard PTM module relies solely on passive advection or movement of particles according to the hydrodynamics of the system. The ePTM adds elements of fish behavior, such as swimming and holding, to the particle transport; these behavioral elements are governed by abiotic conditions and particle response to them. The ePTM also includes predator-induced mortality (see next FAQ).

- **Is predation included?**

Yes. The ePTM uses the “XT Model” of Anderson *et al.* (2005) which characterizes predation-related survival as a function of distance and time travelled by the particle, predator density, predator reaction distance, and a random movement component.

- **What species does the ePTM represent?**

To date, the ePTM has been calibrated to behavior of late-fall run Chinook salmon smolts outmigrating through the northern Delta. Though not yet calibrated for additional species and runs, or central or southern Delta regions, the ePTM is expected to be an improvement upon the standard PTM for comparing changes in salmonid distribution patterns and fates under alternate operational and hydrologic scenarios.

- **What data were used to calibrate the ePTM?**

The calibration has relied on mark-recapture data from acoustic telemetry studies of late fall-run Chinook salmon smolts that were released into the Sacramento River in December and January of 2006 through 2009. The results provide information on fish traveling through the mainstem Sacramento River, Steamboat Slough, Sutter Slough, Georgiana Sough, and the Mokelumne River via the Delta Cross Channel. This is used to infer survival probabilities in each reach and the probability of routing.

- **Why isn't the ePTM calibrated to south Delta data?**

Initial efforts have focused on the north Delta because there is a rich source of acoustic telemetry data to use in the calibration. Calibrating the ePTM to south Delta data is a time-intensive effort that likely would not have been completed in time for a spring 2015 pilot application. Considering this, NMFS decided to advance the initial calibration rather than pause that and shift resources to a south Delta calibration effort at this time.

- **What dictates particle “behavior”?**

The particle behavior is based on the direction and velocity of flow, the variation (standard deviation) of water velocity, stage, and the geographic location of the fish.

- **Does behavior change based on location (e.g., upriver vs. Bay)?**

Yes. The current version has region-specific parameters; riverine, transitional, and tidal areas have different values for the parameters that characterize behavior and mortality probabilities for those regions. This allows a “shift” from one “behavior” to another as the particle travels through the system. This could be switched to reach-specific behavior, depending on results of model calibration.

- Will the particles have the same behavior in the same conditions?**
 On average, particles within a region (i.e, riverine, transitional, and tidal) will behave similarly, since the same parameters would apply given the abiotic conditions. However, some behavioral elements, such as swimming speed, differ between riverine, transitional, and tidal regions, so particle response to similar hydrologic conditions may be region-specific. The ePTM also includes multiple sources of stochasticity that influence the fates of individual particles under a given set of conditions. For example, probability distributions that are functions of current conditions are used to model mortality, route selection at junctions, and an individual's assessment of which direction is "downstream."
- What do fish do at junctions?**
 While the current calibration of the ePTM maintains the standard PTM method of routing particles in direct proportion to flow, future calibrations may introduce more complex routing functions such as non-linear flow relationships or combined width- and flow-based routing.
- Has the ePTM been applied previously?**
 No. This is the initial application of the ePTM to inform management and operations decisions.
- Is there an example of ePTM output with actual data?**
 At the moment, only raw output data are available. NMFS/DOSS are working to generate some standard output summaries and plots.
- What interpretations or conclusions is the current version of ePTM best suited to inform?**
 This is still being determined. Because the model is in relatively early development stages, it is not clear which operational modifications it could best inform. This pilot application will help to determine the model's strengths and limitations.